

# Subscale Water Based Phase Change Material Heat Exchanger Development

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Supplemental heat rejection devices are required in many spacecraft as the radiators are not sized to meet the full heat rejection demand. One means of obtaining additional heat rejection is through the use of phase change material heat exchangers (PCM HX's). PCM HX's utilize phase change to store energy in unfavorable thermal environments (melting) and reject the energy in favorable environments (freezing). Traditionally, wax has been used as a PCM on spacecraft. However, water is an attractive alternative because it is capable of storing about 40% more energy per unit mass due to its higher latent heat of fusion. The significant problem in using water as a PCM is its expansion while freezing, leading to structural integrity concerns when housed in an enclosed heat exchanger volume.

Significant investigation and development has taken place over the past five years to understand and overcome the problems associated with water PCM HX's. This paper reports on the final efforts by Johnson Space Center's Thermal Systems Branch to develop a water based PCM HX. The test article developed and reported on is a subscale version of the full-scale water-based PCM HX's constructed by Mezzo Technologies. The subscale unit was designed by applying prior research on freeze front propagation and previous full-scale water PCM HX development. Design modifications to the subscale unit included use of urethane bladder, decreased aspect ratio, perforated protection sheet, and use of additional midplates. Testing of the subscale unit was successful and 150 cycles were completed without fail.